To the gem dealer the book is invaluable, as it gives him at once all that he needs in his business; to the lover of art it will afford many an hour of pleasure; to the gem collector it gives numerous points of interest concerning the rare stones; and to the mineralogist it will prove a veritable mine of information, even in those subjects with which he thinks himself already conversant. Nor will the general reader, if well informed, be disappointed in his perusal of its pages, for he will find everywhere items of news that will add to his stock of useful knowledge, and suggestions that will help to develop his appreciation of the beautiful.

The setting in which the "Gems and Precious Stones of North America" appears is well worthy of such lovely products of nature. The publishers have spared no efforts to enhance their beauty by an appropriate mounting. The plates and illustrations in the volume are excellent, the letter-press is marred by few errors, the paper is heavy, soft, and well tinted, and the binding is very tasty. We expect to hear of the books meeting a ready sale during the coming holiday season, for surely no more acceptable gift could be imagined than a handsome volume on a topic of such interest as the production of exquisite gems in prosaic North America.—W. S. B.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Age and Origin of the Crystalline Rocks of Missouri.[1]—The Geological Survey of Missouri is indebted to Mr. Haworth for a valuable paper on the age and origin of the crystalline rocks of that state. Mr. Haworth's study of these rocks began in the summer of 1886, and he has ever since pursued the subject with enthusiasm and zeal. His paper embodies the more important results obtained from a somewhat extended examination of the crystalline rocks in the vicinity of Pilot Knob. Field work has been supplemented with laboratory examination, and his conclusions are as follows:

I. As to age, he agrees with other geologists in referring them to Archean time.

[1]The Age and Origin of the Crystalline Rocks of Missouri. By Erasmus Haworth. Bull. No. 6, Geol. Surv. of Missouri.

II. As to origin, he is at variance with others who have worked in the same field, in that he holds the porphyries as well as the granites to be ancient eruptives rather than metamorphosed sediments.

The Archean age of these rocks had been fully established, but Mr. Haworth's observations gave him new evidence, confirming the accepted view, which he groups under two heads :

1. Absence of contact metamorphism in the surrounding Paleozoic rocks.

2. Inclusion of numerous fragments of crystalline rocks almost everywhere, in both sandstone and limestone.

In proof of his eruptive theory of the origin of the rocks, Mr. Haworth presents the following evidence in detail :

A. Field evidence of the eruptive origin. 1. Absence of true bedding. 2. Flow structure, banded structure, and lithophysæ. 3. Breccia. 4. Scoria and amygdaloids. 5. Tuff. 6. Absence of gradations of crystalline into non-crystalline rocks.

B. Petrographic evidence of the eruptive origin. 2. Texture of the ground-mass in the porphyries and breccias. 2. Flow structure in the porphyries and breccias. 3. Broken crystals due to the flowage of lava after the crystals were formed. 4. Magmatic corrosion of porphyritic crystals, and of fragments in the breccia. 5. Amygdaloids. 6. Absence of metamorphic minerals.

The paper is well illustrated with plates and sketch maps, which add materially to its value.

The Sulak Gorge.—In a paper on the Transverse valleys in the Eastern Caucasus, Professor Sjögren gives the following description of the Sulak Gorge, below Gimri, in Daghestan : "Among the many valleys of Daghestan that are interesting to the geologist, there are none more remarkable than the channel by which the river Sulak passes through the chain of Cretaceous and Jurassic mountains which borders Inner Daghestan. Just above the entrance to this defile the four rivers Koissu unite in one stream, which, in series of cataracts, tears through a tremendous chasm some fifteen miles in length, cutting the huge ridge almost at right angles to its axis.

"The gorge traverses the main ridge in the direction north, forty degrees east, then changes its line to northwest, which it still follows at the widening of the valley below Tjirkei, and finally comes back to due north, as it passes through the Tertiary hills below Subut. . . . The huge cutting has a vertical depth of from 5,000 to 6,000 feet, while its breadth is so small that the river leaves no room for a proper

road, and scarcely enough for a narrow horse-path, which is itself impassible at certain seasons of the year. The walls of the defile, which mainly consist of a compact dolomite limestone, and show the lines of stratification with unusual distinctness, rise almost perpendicularly into the air, and are altogether unscalable." (*Geol. Mag.*, Sept., 1891.)

An Olenellus Zone in the Northwestern Highlands of Scotland.—At the last meeting of the British Association for the Advancement of Science, Sir Archibald Geikie read an important paper on the results of the geological survey work in Scotland. After referring to the various sedimentary formations which overlie the Lewisian gneiss, and the unsatisfactory evidence of the fossil remains in them as to their stratigraphical correlation, he described the discovery of a peculiar zone of blue or black shales which from their unaltered character promised to be fossil-bearing. This zone lies in what is known as the "Fucoid beds" a few feet below the persistent band of "Serpulite grit." A search was at once begun, and resulted in the finding of undoubted fragments of Olenellus. More recently additional pieces of Olenellus, including a fine head-shield with eyes complete, have been found in another thin seam of black shale interleaved in the "Serpulite grit." The finding of this fossil among the rocks of the Northwest Highlands, and its association with the "Serpulite grit," afford valuable materials for comparison with the oldest Paleozoic rocks of other regions. The "Fucoid beds" and "Serpulite grit," which intervene between the quartzite below and the Durness limestone above, belong to the lowest part of the Cambrian system. The quartzites form the arenaceous base of that system, while the Durness may be Middle or Upper Cambrian. The marked unconformability which intervenes between the Torridon sandstone and the overlying quartzite points to a long interval having elapsed between the deposition of the two discordant formations. The Torridon sandstone must therefore be pre-Cambrian. (*Nature*, Sept. 17th, 1891.)

Origin of Petroleum.—In a recent paper Mr. Ross has endeavored to prove that petroleum is mainly generated by the action of solfataric volcanic energy upon beds of limestone, and gives equations to show that the action of sulphur dioxide and sulphuretted hydrogen on carbonate of lime, with or without water and peroxide of hydrogen, is capable of producing the ethylene and marsh gas derivatives. (*Nature*, Sept. 17th, 1891.)

A Stegocephalian Skull from the Kilkenny Coal Measures.—Dr. Lydekker has described and figured a Labyrinthodont to which he gives the name *Ichthyerpetum hibernicum.* The interest of the specimen lies in the relationships of the genus to which it belongs. Mr. Lydekker believes it to be a member of the group containing Brachyops, Bothriceps, and Micropholis, all of which are characterized by their more or less parabolic skulls and forwardly placed orbits. Also, certain lines of evidence point to the conclusion that Ichthyerpetum and Pholidogaster are identical. In that case, the type of Stegocephali common throughout the European Carboniferous was represented in the Lower Gondwanas by the genus Brachyops, while we find it surviving in the Hawkesbury beds of Australia, where it is represented by Bothriceps; a member of the latter genus, together with Micropholis, also occurring in the great Karoo system of South Africa. This seems to be another instance of the persistence of types in the Indian, Australian, and Ethiopian regions during long ages after their total disappearance from the palæarctic area. (*Quart. Journ. Geol. Soc.*, Vol. XLVII., Pt. 3, 1891.)

A New Ichthyosaurus.—Dr. Albert Gaudry calls attention to a gigantic Ichthyosaurus, which, after having figured in the exposition of 1889, has been generously donated to the Natural History Museum of Paris by MM. Millot, the owners of the quarries where it was discovered. This fossil was found in the chalk of the Upper Lias of Sainte-Colombe, near l'Isle-sur-Serein, about 12 kilometers from Vassy (Yonne). It is the largest Icthyosaurus ever found in France, measuring 8 metres in length. The head is 1m, 57 long; the anterior extremity is broken, but its length is judged to be about 1m, 80,—that is to say, 24 centimeters more than *Ichthyosaurus platyodon* of England; the eye, ornamented with sclerotic plates, has a diameter of cm. 24; the snout is very much prolonged, and there are about 24 teeth on one side, counting those of both upper and lower jaws; twenty-four vertebræ, altogether 4m, .40 in length, are preserved. The anterior and posterior limbs are joined to the skeleton, but many of their bones are lost, and the remaining ones are scattered.

After having compared this magnificent reptile of Burgogne with other known Ichthyosaurs, M. Gaudry considers it intermediate between the two principal groups, those of Longipinnes and Latipinnes, and proposes to name it, provisionally, *Ichthyosaurus burgundiæ.* (*Revue Scientifique*, Aug., 1891.)

The Skull and Hind Extremity of Pteranodon.—Early in the season of 1876 the writer collected from the Cretaceous of Kansas the first approximately complete skull known of an American Pterodactyl. Upon this specimen Professor Marsh, in the June number of the *American Journal of Science* for that year, founded the "order" Pteranodontia, expressly stating of the specimen that it might be "regarded as the type of the genus Pteranodon." Eight years later, in the May number of the same journal, he gave a fuller description of this same specimen, figuring it under the name *Pteranodon longiceps*.

The specimen consists of the skull alone, and was discovered partly exposed on a gently sloping surface, in the vicinity of Monument Rocks. Aside from an unfortunate stroke of the pick that chipped off the tip of the bill, the specimen was otherwise incomplete, in that the distal part of the occipital crest was lost. In his plate Professor Marsh restored this crest from the indications presented by the basal portion, but without indicating in his paper that such a conjectural restoration had been made. The result is unfortunate.

The writer the present season has been fortunate in securing for the University of Kansas a yet more complete skull of apparently the same species, discovered by his assistant, Mr. E. G. Case, in the immediate vicinity of the place where Professor Marsh's specimen was found. The specimen, while agreeing essentially with the type specimen, has a crest not more than half as long as that figured by Marsh, and with a very different outline, in that the posterior inferior border is angulated and concave. The crest is much thinner than is figured by the artist. The animal did not have nearly so remarkable a skull as the figures would indicate.

"There was apparently no ring of bony sclerotic plates, since in the best preserved specimens no traces of this has been found."[2] Nevertheless, well ossified sclerotic plates do exist in Pteranodon, as our specimen shows. They are from six to eight millimeters in diameter, and similar in texture and shape to, though without the imbrications of, those of the Mosasaurs (the so-called dermal scutes of Marsh).

Several unusually perfect specimens in the Museum of Kansas University enable me to give the chief characters of the pelvis and legs of Pteranodon, parts hitherto but little known,[3] and which will be supplemented, as also those of the skull, by figures given later.

In no especial respect do those parts present unusual features among

[2] Marsh, *Amer. Journ. Sci.*, XXVII., p. 425.

[3] See Marsh, *Amer. Journ. Sci.*, Dec., 1876.

the Pterodactyls. The ilium has a long anterior projection, with an expansion at or near the front end. Posteriorly it extends more stoutly upward and backward from the acetabulum, to form a close union with the three posterior sacral vertebræ, terminating in a stout, styliform tuberosity on either side of the base of the tail. The pubis and ischium are thoroughly coössified throughout (there may be a slit-like indication of an obturator foramen below), forming a broad, anteroposterior plate, which is narrowed to form a symphysis of about one inch in length, in the medium-sized species. Projecting downwards and forwards, about midway between the acetabulum and symphysis, there is a moderately thickened, angular projection, evidently tipped with cartilage in life. It corresponds to the pectineal process, and may have been for the attachment of pectineal or rectus muscles, or for the so-called prepupic bone, a bone I have never seen in the hundreds of specimens which I have examined. A little below the acetabulum, and a little before the middle of the conjoined plate, there is a moderate sized, oval, anteroposterior, pubic foramen. On the border of the ischium behind, a little above the symphysis, is another tuberosity, larger and stouter than the pubic one. Between this tuberosity and the iliac tuberosity directly above, there is a large, deep sciatic notch. These two tuberosities seem to indicate that the animal in life was in the habit of resting upon these parts, a supposition further helped by the weakness of the legs and by the structure of the femur. There are indications of seven sacral vertebræ in the specimen described. Marsh has given five as the number in one species. With the specimen were two apparantly basal caudal vertebræ of small size. The femur is a moderately stout bone, considerably shorter than the tibia, considerably curved, with a slender neck, set at only a slight angle with the shaft, nearly spherical head, and small trochanter,—all of which, together with the rather shallow imperforate acetabulum, would indicate great freedom of movement in the legs. The tibia is a slender bone, without marked cranial crest, and with a well-developed trochlear surface below. I know of no indications of a separate fibula. The foot is elongate and slender, the metatarsals articulating closely together above, the claws much smaller than those of the manus, and only slightly curved. There are three tarsal bones, two of them cuboid or angular, the third larger, and with a downward directed, pointed, hook-like process. It evidently indicates a rudimentary digit. There are four functional toes, the four elongate metatarsals in length indicated by the numbers 2, 1, 3, 4, of which the second is the largest. The phalanges may be represented by the formula I-2, II-3, III-4, IV-5;

thus, as in the European Pterodactyls, corroborating the evidence that the fifth toe is the one that is rudimentary. All these phalanges are slender, excepting the second ones in the third and fourth toes, where they are scarcely longer than wide.

From evidence obtained in the field and in the laboratory, I think I can safely say the following in general of the American Cretaceous Pterodactyls. About five or six species are known, varying in size, when alive, of from about four feet to not over twenty feet in expanse of wing.[4] The head (in all the larger species, at least) was elongate and slender, with a well-developed occipital crest, and without teeth. The jaws may have been encased in horn, but I have never seen any evidence whatever that such was the case. The neck was moderately elongate and slender; the thoracic girdle very stout and rigid, supported above, in some species at least, by union with the coössified thoracic vertebræ, below by the stout anterior projection of the large, rounded, thin sternum. The arms and wrists were very powerful; the second, third, and fourth fingers, as Marsh has shown, small and short, but terminating in strong, recurved claws; the fifth, or extraordinarily developed wing-finger, having very great freedom of backward movement at the extremity of the elongate metacarpal, and with only limited motion between the four phalanges. The body was short, the pelvis of moderate size, the hind legs comparatively small, with great freedom of movement, the tail short, and the feet without much, if any, prehensile power. Their food probably consisted of fishes.[5]

All the bones throughout the skeleton are very thin-walled and pneumatic. The haversian canals and lacunæ are small.—S. W. WILLISTON.

Geological News.—General.—Mr. J. B. Tyrrell reports a deposit of mineral resin resembling amber along the ridge of a beach on the west shore of Cedar Lake, North Saskatchewan, Canada. It has evidently been washed up on shore by the waves, but its exact age has not been determined. (*Am. Journ. Sci.*, October, 1891.)

Archean.—Mr. J. W. Gregory is convinced that the Tudor specimen of Eozoon is not of organic but of mineral origin. (*Quart. Journ. Geol. Soc.*, August, 1891.)

[4] This expanse has often been given much greater than this, but I have actually measured the largest species (*P. umbrosus* Cope), and know that the size cannot exceed that given above.

[5] Several coprolites found within the above-described pelvis, ellisoidal in shape, and about the size of an almond, showed bones so finely comminuted that their precise character could not be made out.

Paleozoic.—Recent observations by S. Calvin render it certain that the Independence shales do not constitute the lowest number of the series of Devonian rocks of Buchanan county, Iowa, but that they were preceded by brecciated limestone of Devonian age. (*Am. Geol.*, September, 1891.)——Mr. Middlemiss suggests that the sub-Cambrian salt marl of India has no ordinary stratigraphic relations with the rest of the series, but is of plutonic, igneous, or deep-seated origin, introduced in Tertiary times, accompanied by lateral and vertical disturbance, thrusting, and shearing. (Geol. Surv. India Records, Vol. XXIV., Pt. I., 1890.)——Dr. Traquair has catalogued fifty species of fossil Dipnoi and Rhipidopterygia of Fife and the Lothians. The geological interest of these fish beds is the abundance of fish remains in estuarine strata below the horizon of the Millstone grit. (Proceeds. Roy. Soc. Edinburgh, Vol. XVII., p. 385.)——Mr. Davis has described a new fossil fish, *Strepsodus brockbankii*, found in the Limestone of the Upper Coal Measures near Manchester, England. (*Geol. Mag.*, October, 1891.)——A collection of Lower Helderberg fossils from Albany, N. Y., has yielded a new genus of Ostracoda, described by E. O. Ulrich under the name Beecherella. Seven species of this new genus are figured in the October number of the *American Geologist.*

Mesozoic.—Mr. Wilson calls attention to the color-markings on a species of Brachiopoda, *Waldheimia perforata*, from the Lower Lias of Gloucestershire, England. The color indications are in the form of clearly defined concentric bands of black and white, of varying breadth. These bands are bilaterally symmetrical, and correspond in the two valves. (*Geol. Mag.*, October, 1891.)

Cenozoic.—According to G. H. Stone, the following-named classes of deposit are represented in the asphalt fields of Western Colorado and Northeastern Utah: (1) Asphaltic sand-rock, (2) bituminous shales or marls, (3) bituminous limestones, (4) outflow or overflow asphalt. These are lacustrine deposits, and will therefore present conditions somewhat different from those of marine beds. (*Am. Journ. Sci.*, August, 1891.)——Mr. Gilbert attributes the small anticlinal disturbance of a cliff of Devonian shale in Western New York, near Lake Erie, to the post-Glacial rise of temperature and consequent expansion of the rocks. Like other small ridges of Devonian shale in Northwestern Ohio and of Trenton limestone in Northern New York, they are shown to have been formed after the departure of the last ice-sheet. (*Am. Geol.*, October, 1891.)